

Does women's literacy affect maternal health services utilization in Ethiopia? A stratified analysis of 2019 mini Ethiopian Demographic and Health Survey

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Abstract

Background: Maternal mortality remains unacceptably high in sub-Saharan Africa with 533 maternal deaths per 100,000 live births, or 200,000 maternal deaths a year. This is over two-thirds (68%) of all maternal deaths per year worldwide. The lifetime risk of maternal death in low-income countries is 1 in 45. Most maternal deaths can be prevented if births are attended by skilled health personnel. Therefore, the current study examined the utilization of maternal health services among women in different sociodemographic statuses within different literacy strata in Ethiopia.

Methods: A total weighted sample of 3,839 women who gave birth within five years preceding the survey and whose literacy status was measured in the survey were included in this study. The dataset from the most recent Ethiopia Mini Demographic and Health Surveys (EMDHS) 2019 was used for this study. The EMDHS was a community-based cross-sectional study conducted in Ethiopia from March 21 to June 28, 2019. The survey used a two-stage stratified cluster sampling technique. Bivariate and multivariable logistic regression analyses were employed. Adjusted odds ratio (AOR) with a 95% confidence interval (CI) was reported and statistical significance was set at a p-value < 0.05.

Results: In this study, nearly two-thirds (63.8%) of reproductive-age women were illiterate. The overall prevalence of ANC 1, ANC 4, skilled birth attendance, and postnatal care utilization was 74.9%, 43.5%, 51.9%, and 32.0%, respectively. Our analysis also revealed that literate women are more likely to receive ANC 1 (literate vs illiterate, 87.9% vs 67.5%), ANC 4 (59.4% vs 34.5%), skilled birth attendance (73.3% vs 39.7%), and PNC (51.2% vs 21.1) as compared to their illiterate counterparts. Regional variation, wealth status, age at first birth, birth order, and birth intervals were found significant factors associated with maternal health care service utilization among both literate and illiterate reproductive-age women in Ethiopia. Similar to this, ANC booking timing and utilization, age of household head, and religious affiliation were associated with institutional delivery and PNC utilization.

Conclusion: Women's literacy is an important associate for utilizing appropriate maternal healthcare, with other sociodemographic and obstetric related factors as modifying factors. Hence, wholehearted efforts should be directed toward educating and empowering women. On the other hand, literacy levels and other modifying factors should be considered when designing interventions that enhance maternal health care service utilization. For instance, such programs need to stratify the interventions according to the literacy level of the women.

Introduction

Globally, maternal mortality declined by almost 38% from 2000 to 2017. Yet over 800 women continue to die each day due to complications of pregnancy and childbirth with the majority of deaths in low- and middle-income countries. The Sustainable Development Goals (SDGs) 3.1 sets out that by 2030, the global maternal mortality ratio (MMR) is reduced to less than 70 per 100,000 live births, and no country should have an MMR of more than 140 per 100,000 live births [1, 2]. Given the current pace of progress, it

is estimated that the world will fall short of the global SDG target by more than one million lives as well as a burden on maternal health and well-being. While many nations have achieved tremendous progress, inequitable coverage of essential maternal and perinatal health interventions continues to be a barrier in many places. In 2015, the strategies for Ending Preventable Maternal Mortality (EPMM), a global multi-partner initiative, outlined broad strategies for maternal health programs [1–3]. EPMM aims to improve maternal health and wellbeing and achieve the SDG target for MMR [4].

Ethiopia has achieved significant improvements in priority areas such as maternal and child health. Ethiopia's National Health Care Quality Strategy for 2016–2020 placed Maternal, Newborn, and Child Health as a priority with the ambitious goals to reduce the MMR from 412 to 199 per 100,000 live births by 2020. Maternal health service utilization has been endorsed as the cost-effective approach to alleviating the burden of maternal deaths [5]. Besides, poor maternal health outcomes have been associated with the underutilization of maternal health care services. Completion of the maternal health continuum of care is very low in Ethiopia and most are engaged with considerable dropouts [6]. According to the Ethiopian Demographic Health Survey (EDHS) 2016, 62% of pregnant women undergo at least one antenatal care visit, 26% of women gave birth in a health institution, and 16.5% of women received postnatal care in Ethiopia [7]. The mini EDHS 2019 also reported that 74% of women received at least one ANC, 43% had four or more ANC visits, 50% of the mother delivered by a skilled birth attendant, and 34% of women received postnatal care check-ups in the first two days following delivery [8].

Literacy is a strong predictor of the use of maternal health care services [9]. There is abundant literature on the relationship between women's education and maternal health outcome and increased antenatal and postnatal care, and skilled birth attendance [10]. A study done in 21 districts in India revealed that literate women are more likely to receive both any ANC and full ANC as compared to their illiterate counterparts. It is also found that literacy has an important role in raising the level of institutional delivery and lowering post-delivery complications [11]. Yadav et al. also reported that education is indeed an important factor that affects maternal healthcare utilization. Education of the mother even if only up to the primary level affects women's maternal healthcare use [12]. A study elsewhere reported that extended women's years of schooling would reduce the probability of several maternal health complications, decrease short birth intervals and unwanted pregnancies, and increase use of antenatal healthcare. It also enables women to own a good understanding, economic resources, and autonomy to seek care for maternal health and child services [13]. Amwonya et al. also reported that female education indeed had a positive impact on maternal health care utilization [14]. A review study in Ethiopia also revealed that educational status is associated with a higher likelihood of having a continuum of maternal healthcare services [15].

Empowering women through education will increase the utilization of maternal healthcare services. The findings of a systematic review conducted by Tekelab et al. reported that about 65% of women utilize ANC services and women's education was positively associated with ANC services utilization in Ethiopia [16]. A systematic review study in sub-Saharan African countries recommended encouraging female enrolment in schools to enhance ANC service utilization [17]. Similarly, Adane et al. also reported 31%

institutional delivery service utilization in Ethiopia and a significant association between mother's educational status and utilization of institutional delivery service [18]. Besides, a study on postnatal care (PNC) utilization in Ethiopia reported that 32% of women utilized the service. In contrast to other literature, this review reported no association between the use of PNC services and mothers' education [19].

The finding of Dimbuene et al. revealed that the relationship between women's education and different components of maternal health service utilization is largely contingent on socioeconomic circumstances at the household level, and nations' maternal health service coverage and socioeconomic development. The household socioeconomic circumstance depicts the inequities in access to high-quality maternal health services [10]. In Ethiopia, the percentage of women with no education has decreased over the years, from 75% in 2000 to 40% in 2019 [8]. Therefore, the current study examined the utilization of maternal health services among women in different sociodemographic statuses within different literacy strata in Ethiopia. The purpose of this study is to investigate the impact of women's literacy on maternal health care service utilization in Ethiopia using three proxy measures of maternal healthcare utilization namely; ANC service utilization during pregnancy; skilled birth attendants during labor; and utilization of postnatal services after the delivery.

Hypotheses

There is a significant relationship between women's literacy and maternal healthcare utilization.

Methods

Study setting and data source

This research was performed based on a dataset from the 2019 EMDHS. EMDHS is the second EMDHS and the fifth DHS implemented in Ethiopia. The Ethiopian Public Health Institute conducted the survey in collaboration with the Central Statistical Agency and the Federal Ministry of Health, with technical assistance from ICF and financial as well as technical support from development partners. The 2019 EMDHS generates data for measuring the progress of the health sector goals set under the Growth and Transformation Plan, which is closely aligned with the SDGs. The study is a national community-based cross-sectional study conducted from March 21 to June 28, 2019. Ethiopia is the second-most populous country in Africa, next to Nigeria with an estimated population of 114.96 million in 2020. Ethiopia is divided into two administrative cities and nine regions. The sample for the 2019 EMDHS was designed to provide estimates of key indicators for the country as a whole, for urban and rural areas separately, and for each of the nine regions and the two administrative cities.

Study population and sampling procedure

The EMDHS samples were collected using stratified and two-stage cluster sampling methods. In the first stage, each region was stratified into urban and rural areas. A total of 305 enumeration areas (EAs) (93 in urban and 212 in rural areas) were selected with probability proportional to EA size. In the second stage

of selection, a fixed number of 30 households per cluster were selected with an equal probability of systematic selection from the newly created household listing. In the survey, 8,663 households were included and, data were collected from 8,855 women of reproductive age (age 15-49). All women aged 15–49, who were either permanent residents of the selected households or visitors who slept in the household the night before the survey, were eligible to be interviewed. All reproductive-age women who gave birth within five years preceding the survey in the selected enumeration areas were the study population. A total weighted sample of 3,839 women who gave birth within five years preceding the survey and whose literacy status was measured in the survey was included in this study. Those women whose literacy status was not assessed (i.e. no card with required language and blind or visually impaired) were excluded from this analysis. The detailed methodological procedure was presented in the full EMDHS 2019 report [8].

Measurement of variables

The outcome variable of the study was maternal health service utilization among reproductive-age women (women aged 15–49). We have considered three basic reproductive health services namely antenatal care, institutional delivery, and postnatal services as a measure of MCH utilization. The independent variables were literacy status, maternal age, marital status, religion, region, wealth index, place of residence, family size, sex of head of households, age of household head, births in the last five years, total children ever born, number of living children, age of respondent at first birth, number of under-five children, sex of the recent newborn, birth order, ANC 1, ANC 4, Timing of first ANC, and birth interval (See Table 1).

Data management and analysis

The weighted data were used for the overall analysis to get reliable statistical estimates by compensating for the unequal probability of selection between strata and the non-response rate among study participants. Descriptive and summary statistics were conducted using STATA version 14 software. A detailed explanation of the weighting procedure can be found in the EMDHS methodology report [8]. Multi-collinearity was checked using variance inflation factors (VIF) and the value of all variables in the final model was less than five. Bivariate and multivariable binary logistic regression was employed. Variables having a p-value of less than 0.25 in the bivariate analysis were selected as candidate variables for the multivariable logistic regression analysis. Both crude and Adjusted Odds Ratio (AOR) with corresponding 95% Confidence Interval (CI) were reported. The threshold for statistical significance was set at $p < 0.05$.

Ethical considerations

This research used secondary data from demographic and health survey repositories. Permission was obtained from the Measure DHS program to access and analyze the data (<http://www.measuredhsprogram.com>). During EMDHS data collection, informed consent was taken

from each participant and confidentiality was maintained. The survey data do not contain all identifying information.

Results

Socio-demographic characteristics of the respondents

A total of 3839 reproductive-age women were included in the analysis. Nearly three-fourth 2843 (74.1%) of them were rural residents. Nearly one-third (30.4%) of women were aged 25–29 years. About 1439 (37.5%) were affiliated with orthodox religion and 1516 (39.5%) were from the Oromia region. More than half (51.2%) of the women had no education and only 153 (4.0%) respondents attended higher education. Nearly half (50.2%) of the women had more than five family size. In this study, 807 (21.1%) women were in low income households. The majority (87.3%) of the women live in male headed households (**Table 2**).

Obstetric related characteristics of the respondents

More than one half (53.7%) and 2181 (56.8%) of the respondents had 1-3 ever born and live children, respectively. Out of the total respondents, 2015 (52.5%) were in the aged less than 18 years during their first birth. About 2471 (64.4%) of the women had one birth in the past five years. Slightly more than half (52.3%) of women had male child of their recent birth (**Table 3**).

Literacy status of the respondents

With regard to the literacy status of reproductive-age women who gave birth in the last five years, nearly two-third (63.8%) of them were illiterate (**Figure 1**).

Prevalence of maternal health service utilization

In this study overall ANC 1, ANC 4, skilled birth attendance, and postnatal care utilization is 74.9% (73.5, 76.2), 43.5% (42.0, 45.1), 51.9% (50.3, 53.4), and 32.0% (30.6, 33.5), respectively. About 67.5% and 87.9% illiterate and literate reproductive-age women have at least one ANC visit during their last pregnancy, respectively. On the other hands, 39.7% and 73.3% illiterate and literate women gave birth at health facilities during their last pregnancy, respectively. With regard to postnatal care, only 21.1% illiterate and 51.2% literate women had used postnatal care. As depicted in the **Figure 2** there was a significant association between women literacy status and maternal health care utilization among reproductive age women in Ethiopia ($p < 0.001$) (**Table 4**).

Factors associated with maternal health service utilization

Antenatal care

In multivariable regression, among illiterate women, the odds of ANC utilization was nearly 2 times higher among women aged 25-34 years [AOR = 2.33; 95%CI: 1.57, 3.45] and 35-49 years [AOR = 2.01; 95%CI:

1.22, 3.33] as compared to women aged less than 24 years. The odds of ANC utilization among illiterate women was 80% [AOR = 0.20; 95%CI: 0.07, 0.53], 67% [AOR = 0.33; 95%CI: 0.17, 0.62], 81% [AOR = 0.19; 95%CI: 0.10, 0.39], 95% [AOR = 0.05; 95%CI: 0.02, 0.12], and 75% [AOR = 0.25; 95%CI: 0.12, 0.50] lower among those living in Afar, Amhara, Oromia, Somali, and SNNP regions of Ethiopia as compared to women living in Tigray region, respectively. The odds of ANC utilization among illiterate women from households with poorer, middle, richer and richest wealth status were 2.00 [AOR = 2.00; 95%CI: 1.54, 2.61], 2.78 [AOR = 2.78; 95% CI: 2.05, 3.77], 2.93 [AOR = 2.93; 95%CI: 2.11, 4.08], and 3.56 [AOR = 3.56; 95%CI: 2.06, 6.17] times higher as compared to those from households with poorest wealth status. Women living in female headed households were 28% [AOR = 0.72; 95%CI: 0.59, 0.88] lowers odds of ANC utilization as compared to their counterparts. Women aged 25 years and higher during their first birth were 57% [AOR = 0.43; 95% CI: 0.26, 0.71] less likely to utilize ANC than women who had their first birth before the age of 18 years old. Four to six [AOR = 0.61; 95%CI: 0.43, 0.87] and seven and above number of birth order [AOR = 0.43; 95% CI: 0.27, 0.66] were associated with 39% and 57% lower odds of ANC utilization as compared to less than 3 birth order, respectively. About one month's increase in preceding birth interval was associated with 1.01 [AOR = 1.01; 95%CI: 1.001, 1.011] times higher odds of ANC utilization (**Table 5**).

Among literate women, the odds of ANC utilization was 2 times higher among literate women aged 25-34 years [AOR = 2.01; 95%CI: 1.15, 3.52] as compared to women aged less than 24 years. The odds of ANC utilization among literate women living in rural area were 3.24 [AOR = 3.24; 95%CI: 1.88, 5.59] times higher as compared to the urban counterparts. The odds of ANC utilization among literate women was 88% [AOR = 0.12; 95%CI: 0.03, 0.45], 98% [AOR = 0.02; 95%CI: 0.002, 0.11], and 95% [AOR = 0.05; 95%CI: 0.01, 0.18] lower among those living in Oromia, Somali, and SNNP regions of Ethiopia as compared to women living in Tigray region, respectively. The odds of ANC utilization among literate women from households with poorer, middle, richer and richest wealth status were 3.72 [AOR = 3.72; 95%CI: 1.88, 7.36], 6.26 [AOR = 6.26; 95% CI: 3.41, 11.47], 14.70 [AOR = 14.70; 95%CI: 7.54, 28.66], and 94.10 [AOR = 94.10; 95%CI: 37.30, 237.35] times higher as compared to those from households with poorest wealth status. The odds of ANC utilization was 2.71 [AOR = 2.71; 95%CI: 1.68, 4.36] times higher among literate women aged 18-24 during their first birth than women aged below 18 during their first birth. Women aged 25 and higher years during their first birth were 67% [AOR = 0.33; 95% CI: 0.14, 0.82] less likely to utilize ANC than women who had their first birth before 18 years old (**Table 5**).

Institutional delivery

In the multivariable analysis, the following factors were associated with institutional delivery among literate and illiterate women in Ethiopia. Among illiterate women who had first and fourth ANC visit was 5.30 [AOR = 5.30; 95%CI: 4.00, 7.02] and 2.28 [AOR = 2.28; 95%CI: 1.84, 2.83] times more likely to deliver at health institution as compared to their counterparts. The odds of institutional delivery among illiterate women was 40% [AOR = 0.60; 95%CI: 0.42, 0.84], 62% [AOR = 0.38; 95%CI: 0.28, 0.51], and 59% [AOR = 0.41; 95%CI: 0.19, 0.92] lower among women affiliated with Orthodox, Protestant, and other religion (Catholic and traditional) as compared to women who have been following Muslim religion. The odds of institutional delivery among illiterate women was 63% [AOR = 0.37; 95%CI: 0.14, 0.99] lower among

women living in Afar region as compared to women living in Tigray region. Women who had more than five family size were 33% [AOR = 0.67; 95% CI: 0.51, 0.87] less likely to deliver at health institution than women who had below five family size. The odds of institutional delivery was 1.93 [AOR = 1.93; 95%CI: 1.45, 2.56], 2.20 [AOR = 2.20; 95%CI: 1.62, 2.98], 3.34 [AOR = 3.34; 95%CI: 2.41, 4.63], and 5.71 [AOR = 5.71; 95%CI: 3.53, 9.25] times higher among illiterate women in households with poorer, middle, richer and richest income status as compared to those living in poorest wealth status. Illiterate woman who had three and above births in the last five years was 61% [AOR = 0.39; 95%CI: 0.23, 0.67] lowers odds of institutional delivery as compared to those woman who had one birth in the last five years. Four to six birth order was associated with 33% [AOR = 0.67; 95%CI: 0.43, 0.87] lower odds of institutional delivery as compared to less than three birth order (**Table 6**).

Among literate women who had forth ANC visit was nearly two [AOR = 1.71; 95%CI: 1.22, 2.41] times more likely to deliver at health institution as compared to their counterparts. The odds of institutional delivery among literate women was 51% [AOR = 0.49; 95%CI: 0.29, 0.82], 76% [AOR = 0.24; 95%CI: 0.15, 0.40], and 97% [AOR = 0.03; 95%CI: 0.003, 0.20] lower among women affiliated with Orthodox, Protestant, and other religion as compared to women who have been following Muslim religion. The odds of institutional delivery among literate women was 53% [AOR = 0.47; 95%CI: 0.23, 0.94] and 66% [AOR = 0.34; 95%CI: 0.16, 0.72] lower among women living in Amhara and Oromia regions as compared to women living in Tigray region, respectively. The odds of institutional delivery among literate women from households with poorer, middle, richer and richest income status were 2.65 [AOR = 2.65; 95%CI: 1.25, 5.62], 3.73 [AOR = 3.73; 95% CI: 1.88, 7.39], 8.87 [AOR = 8.87; 95%CI: 4.28, 18.36], and 17.74 [AOR = 17.74; 95%CI: 7.81, 40.31] times higher as compared to those from households with poorest income status, respectively. Literate women aged 25 and higher years during their first birth were 2.56 [AOR = 2.56; 95% CI: 1.13, 5.77] times higher odds of institutional delivery than women who had their first birth before 18 years old. Literate woman who had two births in the last five years was 45% [AOR = 0.55; 95%CI: 0.38, 0.79] lowers odds of institutional delivery as compared to those woman who had one birth in the last five years. Seven and above birth order was associated with 3.43 [AOR = 3.43; 95%CI: 1.12, 10.49] times higher odds of institutional delivery as compared to less than three birth order. One month's increase in timing of first ANC was associated with 2% [AOR = 0.98; 95%CI: 0.96, 0.99] lower odds of institutional delivery. Women living in household head aged 30-44years and 45-59 years were 56% [AOR = 0.44; 95% CI: 0.28, 0.70] and 67% [AOR = 0.33; 95% CI: 0.17, 0.64] less likely deliver at health institution than women living in household headed by less than 29 years old (**Table 6**).

Postnatal care

In the multivariable analysis, the following factors were associated with PNC utilization among literate and illiterate women in Ethiopia. Illiterate women who had first and fourth ANC visit was 5.72 [AOR = 5.72; 95%CI: 3.65, 8.99] and 1.88 [AOR = 1.88; 95%CI: 1.46, 2.42] times more likely used PNC as compared to their counterparts. The odds of postnatal care utilization among illiterate women was 44% [AOR = 0.56; 95%CI: 0.39, 0.81] lower among women affiliated with Protestant religion as compared to women who have been following Muslim religion. The odds of postnatal care utilization among illiterate women was

40% [AOR = 0.60; 95%CI: 0.38, 0.96] and 52% [AOR = 0.48; 95%CI: 0.28, 0.83] lower among women living in Amhara and Oromia regions as compared to women living in Tigray region, respectively. Regarding wealth status of illiterate women, women with poorer [AOR = 1.52; 95%CI: 1.04, 2.22], middle [AOR = 1.72; 95% CI: 1.15, 2.56], richer [AOR = 2.56; 95%CI: 1.70, 3.85], and richest [AOR = 3.98; 95%CI: 2.29, 6.91] wealth status were more likely utilized postnatal care as compared to those in poorest households income status. Illiterate women with optimal [AOR = 1.46; 95%CI: 1.01, 2.12] and long [AOR = 1.85; 95%CI: 1.16, 2.97] inter-birth intervals were associated with higher odds of postnatal care utilization as compared to short inter-birth interval. Illiterate women living in household head aged 30-44 years and 45-59 years were 2.57 [AOR = 2.57; 95% CI: 1.56, 4.22] and 2.69 [AOR = 2.69; 95% CI: 1.53, 4.71] times more likely utilized postnatal care than women living in household headed less than 29 years old (**Table 7**).

Among literate women the odds of postnatal care utilization was 38% [AOR = 0.62; 95%CI: 0.39, 0.99] lower among women affiliated with Protestant religion as compared to women who have been following Muslim religion. The odds of postnatal care utilization among literate women was 52% [AOR = 0.48; 95%CI: 0.26, 0.88], 68% [AOR = 0.32; 95%CI: 0.16, 0.61], and 56% [AOR = 0.44; 95%CI: 0.21, 0.92] lower among women living in Amhara, Oromia, and SNNP regions as compared to women living in Tigray region, respectively. Literate women in richer wealth status were 4.51 times more likely to use postnatal care compared to the poorest counterparts [AOR = 4.51; 95%CI: 1.90, 10.71]. Literate women aged 25 and higher years during their first birth were 4.03 [AOR = 4.03; 95% CI: 1.78, 9.15] times higher odds of postnatal service utilization than women who had their first birth before 18 years old. One month's increase in timing of first ANC was associated with 13% [AOR = 0.87; 95%CI: 0.77, 0.99] lower odds postnatal service utilization (**Table 7**).

Discussion

This study examined the relationship between women's literacy status and maternal health service utilization among reproductive age women in Ethiopia. This study addressed three dimensions of maternal health services utilization, namely frequency of ANC, skilled birth attendant during delivery, and PNC. Overall, the result shows consistency with previous literature [10, 16, 18], indicating maternal literacy is positively correlated with maternal health service utilization. This is due to that literacy increases the women's cognitive skills and the ability to seek information. In addition, education is associated with the improvement of economic opportunities, employment status and women autonomy which may help to take the better decision on maternal healthcare utilization [20, 21].

In this study overall ANC 1, ANC 4, skilled birth attendance, and postnatal care utilization is 74.9%, 43.5%, 51.9%, and 32.0%, respectively. A systematic review reported that only a quarter (25.5%) of the women in had used a complete continuum of care (at least four ANC visits, skilled birth attendant, and at least one PNC within 6 weeks after delivery) in Ethiopia [15]. Another systematic review reported that 64%, 31%, and 32% of women in Ethiopia utilized ANC, institutional delivery, and PNC service, respectively [16, 18, 19]. Similarly, in sub-Saharan Africa countries, 58.5%, 66%, and 52.48% of women utilized ANC, institutional

delivery, and PNC service, respectively [22–24]. The discrepancy may be due to difference in access to health facilities and sociodemographic factors.

Our analysis further revealed that literate women are more likely to receive ANC 1 (literate vs illiterate, 87.9% vs 67.5%), ANC 4 (59.4% vs 34.5%), skilled birth attendance (73.3% vs 39.7%), and PNC (51.2% vs 21.1) as compared to their illiterate counterparts. Similarly studies on factors associated with maternal health service utilization frequently point out that a higher level of maternal education significantly increases utilization of maternal health services, even after controlling for other socioeconomic factors [10, 25, 26]. This is due to women's literacy increases their capacity to recognize illness symptoms and the desire to seek appropriate health care. In addition to this, well educated women are more responsive to new health-enhancing ideas which strengthens the demand of health care. Besides women's literacy modifies the traditional balance of power with men and enhances women's empowerment, and thus decision-making power at the household and community level [10]. Adane et al., also described this as education makes women more concerned about their health status, able to freely make decisions, and afford the cost of health care services, which ultimately enhances their healthcare utilization [18].

Yet, the relationship between women's education and maternal healthcare service utilization need to be seen under different socioeconomic circumstances. In this study, illiterate women higher age group, higher wealth status, increase in birth interval was positively associated with ANC service utilization while living in Afar, Amhara, Oromia, Somali, and SNNP regions, living in female headed households, increased age at first delivery, and high birth orders were negatively associated with ANC service utilization. Whereas, among literate women, the odds of ANC utilization was positively associated with aged 25-34 years, living in rural area, having higher wealth status, and aged 18-24 during their first birth, while negatively associated with living in Oromia, Somali, and SNNP regions and being aged 25 and higher years during first birth. A systematic review in developing countries reported that maternal education, husband's education, marital status, availability and cost of services, household income, women's employment, media exposure and history of obstetric complications are among the factors affecting antenatal care uptake. In this review women of higher parity tend to use antenatal care less [27]. A recent review also identified socioeconomic status, urban residence, older/increasing age, low parity, being educated and having an educated partner, being employed, being married and Christian religion as predictors of ANC attendance. Awareness of danger signs, timing and adequate number of antenatal visits, exposure to mass media and good attitude towards ANC utilization made attendance more likely [17].

Illiterate women skilled birth attendance was higher among women who had first and fourth ANC visit, and higher wealth status. Skilled birth attendance was negatively associated with women affiliated with Orthodox, Protestant, and other religion, living in Afar region, more than five family size, three and above births in the last five years and four to six birth orders. However, among literate women attending fourth ANC visit, higher wealth status, aged 25 and higher during first birth, and seven and above birth order was positively associated skilled birth attendance. Institutional delivery among literate women was lower

among women living in Amhara and Oromia regions, affiliated with Orthodox, Protestant, and other religion, women who had two births in the last five years, one month's increase in timing of first ANC, and women living in household head aged 30-44 years and 45-59 years. A systematic review in Ethiopia also reported that maternal age at first pregnancy, residence setting, educational status of mothers, availability of information source, ANC follow-up, frequency of ANC follow up, knowledge on the benefits of institutional delivery and danger signs of pregnancy and place of delivery for the most recent birth were factors positively and significantly associated with institutional delivery service utilization [18]. In sub-Saharan African countries giving birth at a health facility declined with increased age and rural residence but increased with the level of education and wealth status [23]. Another study reported that at least primary education, urban residents, fewer children, never married, higher number of prenatal care visits, higher economic level, mass-media exposure and educated husbands are associated with more likely to delivery in health institutions [28].

Illiterate women attending first and fourth ANC visit, higher wealth status, optimal and long birth intervals, women living in household head aged 30-44 and 45-59 years were positively associated with PNC utilization. Whereas, being affiliated with Protestant religion and living in Amhara and Oromia regions were negatively associated with PNC utilization. Among literate women the odds of postnatal care utilization was positively associated with richer wealth status and aged 25 and higher years during their first birth. Whereas, affiliated with Protestant religion, living in Amhara, Oromia, and SNNP regions, and one month's increase in timing of first ANC was negatively associated with PNC utilization. In Ethiopia, ANC, being from urban area, and delivery in health facility had a positive effect on PNC utilization. But mothers' education was not significantly associated with PNC utilization [19]. A study in sub-Saharan Africa also reported region, residence, age group, maternal education, maternal occupation, media exposure, ANC visit, place of delivery, and accessing health care as a determinants of postnatal care utilization [24].

Education and health complement enhance and support each other. Years of formal education are a widely accepted indicator of social status and have been commonly used to explore social inequalities [29]. Women's literacy is an important determinant of the maternal health care service utilization. But the associations between women's education and maternal health care utilization is not linear while conditioned by different socioeconomic factors [10]. A positive relationship is reported between levels of maternal education and health service use even in adverse socioeconomic situations [30]. Moreover, lack of literacy is underlined as one of stressors affecting women during pregnancy and childbirth, creating vulnerability and increasing the likelihood of negative outcomes [31].

Girls' education is the world's best investment with the widest-ranging returns [32]. It is possible that much of the health disadvantage associated with low levels of maternal literacy can be addressed through universal access to education; however, this requires rigorous empirical evidence. Empirical evidence from 108 countries over twenty years has shown that if every woman had a primary education, maternal deaths could fall 66% and save an estimated 189,000 lives per year. The impact of education is particularly greater in sub-Saharan Africa, where education is attributable to a reduction of maternal

mortality from 500 to 150 deaths per 100,000 child births [32, 33]. Kim identified among women in Uganda education have impact on autonomous health care seeking, use of family planning methods, and delivery in hospital. Women literacy is need be conceptualize in it associated with their cognitive skills, socio-economic status, and autonomy within household, it is also thought to be closely related to their maternal healthcare service utilization [34]. Therefore, empowering women through education is a starting point towards enhancing household socioeconomic status, health knowledge and skill, and autonomy in decision-making which ultimately increases maternal healthcare service utilization [32, 34, 35]. Empowerment begins with education, the best development investment by ensuring that girls to attend primary school enable women to read and write and provide them with public health education. Educated girls are more likely to delay marriages and pregnancy, are well informed about what to do before, during, and after pregnancy, thereby reduce the risk of childbirth-related death. Besides, as girls continue their education, they are able to break the bonds of poverty and offset the inequities in access to high-quality maternal health services. If education will increase then most socio-economic backwardness will be abolished.

Strength and limitation

The result of this study should be interpreted in light of some limitations. First, the EMDHS survey relied on women's reports which might have the possibility of social desirability and recall bias. These might underestimate, overestimate, or reverse the association. Besides, the cross-sectional nature of the study didn't allow us to infer the temporal relationship between maternal health care service utilization and the exposures. This study might also be affected because of residual confounding factors that are not assessed in this study. On the other hand, this study has numerous strengths. The main strength of this study was that it used a nationally representative data with large sample size. The study is also based on weighted EMDHS data that can be generalizable to reproductive-age women in Ethiopia.

Conclusion

Our study found that there was a significant association between literacy and the utilization of maternal health care services though other socio-demographic factors also play a significant role. Regional variation, wealth status, age at first birth, birth order and intervals were found significant factors associated with maternal health care service utilization. Similar to this, ANC booking timing and utilization, age of household head, and religious affiliation were associated with institutional delivery and PNC utilization. Therefore, improved education among the women can avail or aware about the knowledge and practices of maternal health care service utilization which will create a new world where pregnancy related complication, maternal mortality and child mortality will reduced. On the other hand, literacy levels and modifying socio-demographic and obstetric related factors should be considered when designing public health interventions and women's empowerment programs. For example, relevant programs need to stratify the interventions according to literacy level of the women.

Abbreviations

ANC: Antenatal care; AOR: Adjusted odds ratio; CI: Confidence intervals; DHS, Demographic and Health Survey; EDHS, Ethiopian Demographic and Health Survey; EMDHS: Ethiopian mini demographic health survey; EPMM: Ending Preventable Maternal Mortality, PNC: Postnatal Care; SD: Standard deviation; SDGs: Sustainable Development Goals; WHO: World Health Organization.

Declarations

Ethical approval and consent to participate

This research used secondary data from demographic and health survey repositories. Permission was obtained from the Measure DHS program to access and analyze the data (<http://www.measuredhsprogram.com>). During EMDHS data collection, informed consent was taken from each participant and confidentiality was maintained. The survey data do not contain all identifying information.

Consent for publication

Not applicable.

Availability of data and materials

The raw data used in this study can be accessed from the DHS website: <http://www.dhsmeasures>.

Competing interests

The authors declare that they have no conflict of interests.

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Authors' contributions

SH conceptualized and conceived the study. SH TDB, GTG, TGD and BTW carried out the statistical analysis. SH, TDB, GTG, TGD and BTW conducted the literature review, SH and TGD wrote draft manuscript GTG, TGD and BTW reviewed and commented the draft manuscript. All authors read and approved the final version of the manuscript.

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Tables

Table 1

List of variables used for analysis and their definition and measurement based on the 2019 EMDHS.

Variable name	Description
Maternal health service utilization	The utilization of maternal health services is defined as a woman visiting and receiving care: ANC visits during pregnancy, institutional delivery, and PNC visit within 42 days from health facilities and skilled professionals.
Antenatal care visits	ANC visits the women had in their recent pregnancy regardless of whosoever the provider of ANC service was. ANC was categorized as "Yes" or "No" and ANC 4 was coded 'less than 4 "No" and '4 and more' as "Yes".
Institutional delivery	Institutional delivery for the last child was categorized as "Yes" for deliveries at governmental, private, and non-governmental health facilities, and "No" for home or other place deliveries.
Postnatal care	Postnatal care is the care given to the mother and newborn following birth until 42 days. Its response was categorized as "yes" or "no"
Literacy status	Literacy level was recoded as "Literate" for women who had attended higher than secondary school and those who were able to read all or part of the sentence and "illiterate" for the women who cannot read at all.
Place of residence	It is the designation of the cluster or enumeration area as an urban area or a rural area.
Maternal age	The age of the women in the year was categorized as less than 24, 25–34, and 35–49
Religion	Religion was categorized as Muslim, Orthodox, Protestant, and Others (catholic and traditional)
Region	The region where the mother resides is recorded as Tigray, Afar, Amhara, Oromia, Somali, Benishangul, South Nation Nationalities and Peoples (SNNP) (including newly formed Sidama and Southwest Ethiopia regions), Gambella, Harari, Addis Ababa, and Dire Dawa
Sex of household head	Women were asked the who is the head of the household and answered as male/female
Wealth index	The wealth index was calculated using data on a household's ownership of selected assets. Each household asset is assigned a weighted score generated through principal components analysis. The scores were standardized and summed, and it was grouped as poorest, poorer, middle, richer, and richest.
Family size	It is the number of household members and recoded as ≤ 5 and above 5.
Births in the last five years	This variable is recoded as one birth, 2 births, and 3 and above births
Age of respondent at first birth	Recoded as less than 18 years, 18–24 years, and 25 and above years
Age of household head	Recoded as less than or equal to 29 years, 30-44, 46-59, and 60 and above years

Birth order	Birth order is the order number of the births from first to last, Recoded as less than or equal to 3, 4-6, and 7 and above.
Birth interval	The birth interval was defined as the duration of months between the birth of the index child and the subsequent live birth. It was recorded as a short birth interval for a birth interval less than 24 months, an optimal birth interval for 25 to 59 months, and a long birth interval for 60 and above months of birth interval.
Timing for first ANC	Timing of first antenatal check

Table 2

Socio-demographic characteristics of reproductive-age women who gave birth in the last five years in Ethiopia, 2019 (n = 3839)

Variable	Description	Weighted frequency (n)	Percent (%)
Age of the respondents	Less than 24	968	25.2
	25-34	1948	50.8
	35-49	923	24.0
Place of residence	Urban	996	25.9
	Rural	2843	74.1
Marital status	Single	20	0.5
	Married	3604	93.9
	Separated/widowed/divorced	215	5.6
Educational level	No education	1967	51.2
	Primary	1381	36
	Secondary	338	8.8
	Higher	153	4
Religion	Muslim	1273	33.2
	Orthodox	1439	37.5
	Protestant	1064	27.7
	Others [#]	63	1.6
Region	Tigray	286	7.5
	Afar	51	1.3
	Amhara	839	21.9
	Oromia	1516	39.5
	Somali	155	4
	Benishangul	46	1.2
	SNNPR	776	20.2
	Gambela	12	0.3
	Harari	11	0.29
	Addis Ababa	125	3.2
	Dire Dawa	21	0.6
Family size	≤ 5	1913	49.8

	> 5	1926	50.2
Wealth index	Poorest	777	20.2
	Poorer	807	21.1
	Middle	754	19.6
	Richer	699	18.2
	Richest	802	20.9
Sex of household head	Male	3350	87.3
	Female	489	12.7
Age of Household head	≤ 29	812	21.1
	30 - 44	2068	53.9
	45 - 59	675	17.6
	≥ 60	284	7.4

#:Catholic and traditional

Table 3

Obstetric characteristics of reproductive-age women who gave birth in the last five years in Ethiopia, 2019 (n = 3839)

Variable	Description	Weighted frequency (n)	Percent (%)
Total children ever born	1 to 3	2061	53.7
	4 to 6	1171	30.5
	≥ 7	607	15.8
Number of living children	1 to 3	2181	56.8
	4 to 6	1226	31.9
	≥ 7	432	11.3
Age of respondents at first birth	≤ 18	2015	52.5
	19-24	1526	39.7
	≥ 25	298	7.8
Births in the past five years	One	2471	64.4
	Two	1215	31.6
	Three and above	153	4.0
Sex of the current Child	Male	2010	52.3
	Female	1829	47.7
Birth order	≤ 3	2061	53.7
	4 to 6	1171	30.5
	≥ 7	607	15.8
Past place of delivery	Home	802	58.6
	Health facilities	550	40.3
	Other	15	1.1
Birth interval	Low birth interval	657	21.8
	Optimal birth interval	1,761	58.4
	Long birth interval	596	19.8
Timing for first ANC	Before 3 months	1,079	37.5
	4 to 6 months	1,542	53.5
	After 7 months	260	9.0

Table 4

Chi-square association between maternal health care utilization and literacy among reproductive-age women who gave birth in the last five years in Ethiopia, 2019 (n = 3839)

Variables	Description	Literacy status			Chi-square (p-value)
		Illiterate, n (%)	Literate, n (%)	Total, n (%)	
ANC visits	No	796 (32.5)	168 (12.1)	965 (25.1)	chi2 = 290.51 p-value < 0.001
	Yes	1653 (67.5)	1222 (87.9)	2875 (74.9)	
ANC 4 and above	No	1604 (65.5)	564 (40.6)	2168 (56.5)	chi2 = 323.14 p-value < 0.001
	Yes	845 (34.5)	826 (59.4)	1671 (43.5)	
Facility delivery	No	1478 (60.3)	371 (26.7)	1848 (48.1)	chi2 = 546.99 p-value < 0.001
	Yes	972 (39.7)	1019 (73.3)	1991 (51.9)	
Postnatal service	No	1932 (78.9)	678 (48.8)	2610 (68.0)	chi2 = 412.06 p-value < 0.001
	Yes	517 (21.1)	712 (51.2)	1230 (32.0)	

Table 5

Bivariate and multivariable analysis of antenatal care utilization among illiterate and literate reproductive-age women who gave birth in the last five years in Ethiopia, 2019 (n = 3839).

Variables	Description	ANC utilization			
		Illiterate		Literate	
		COR (95%CI)	AOR (95% CI)	COR (95% CI)	AOR (95% CI)
Age of the respondent	Less than 24	1	1	1	1
	25-34	1.21 (0.97, 1.52)	2.33 (1.57, 3.45)*	1.52 (1.06, 2.16)	2.01 (1.15, 3.52)*
	35-49	0.81 (0.64, 1.04)	2.01 (1.22, 3.33)*	0.70 (0.44, 1.11)	0.83 (0.34, 2.01)
Place of residence	Urban	1	1	1	1
	Rural	0.59 (0.46, 0.76)	0.82 (0.57, 1.17)	0.64 (0.45, 0.89)	3.24 (1.88, 5.59)*
Religion	Muslim	1	1	1	1
	Orthodox	2.58 (2.09, 3.18)	0.95 (0.65, 1.39)	1.89 (1.20, 2.96)	0.74 (0.40, 1.39)
	Protestant	1.59 (1.29, 1.96)	0.81 (0.60, 1.08)	0.56 (0.37, 0.83)	1.29 (0.73, 2.28)
	Others	0.67 (0.38, 1.16)	0.57 (0.31, 1.04)	0.16 (0.05, 0.57)	0.26 (0.06, 1.20)
Region	Tigray	1	1	1	1
	Afar	0.14 (0.06, 0.31)	0.20 (0.07, 0.53)*	0.31 (0.02, 5.90)	1.33 (0.05, 37.38)
	Amhara	0.37(0.20, 0.68)	0.33 (0.17, 0.62)*	0.52 (0.15, 1.80)	0.54 (0.14, 2.05)
	Oromia	0.17 (0.10, 0.31)	0.19 (0.10, 0.39)*	0.16 (0.05, 0.51))	0.12 (0.03, 0.45)*
	Somali	0.03 (0.02, 0.07)	0.05 (0.02, 0.12)*	0.02 (0.004, 0.07)	0.02 (0.002, 0.11)*
	Benishangul	0.35 (0.12, 0.99)	0.50 (0.15, 1.62)	0.31 (0.04, 2.63)	0.46 (0.04, 5.21)
	SNNPR	0.25 (0.14, 0.46)	0.25 (0.12, 0.50)*	0.06 (0.02, 0.17)	0.05 (0.01, 0.18)*
	Gambela	0.46 (0.05, 4.47)	0.38 (0.03, 5.80)	0.28 (0.01, 6.57)	0.28 (0.01, 10.01)
	Harari	0.25 (0.04, 1.436)	0.18 (0.02, 1.33)	0.35 (0.01, 21.07)	0.11 (0.001, 11.25)

	Addis Ababa	1.13 (0.22, 5.88)	0.84 (0.04, 16.94)	0.73 (0.15, 3.57)	0.27 (0.05, 1.61)
	Dire Dawa	0.29 (0.07, 1.24)	0.32 (0.06, 1.72)	0.44 (0.02, 10.04)	0.16 (0.01, 4.79)
Family size	≤ 5	1	1	1	1
	> 5	0.58 (0.49, 0.69)	0.79 (0.59, 1.08)	0.47 (0.34, 0.65)	0.65 (0.39, 1.06)
Wealth index	Poorest	1	1	1	1
	Poorer	2.37 (1.89, 2.96)	2.00 (1.54, 2.61)*	5.40 (3.00, 9.74))	3.72 (1.88, 7.36)*
	Middle	3.13 (2.43, 4.04)	2.78 (2.05, 3.77)*	4.94 (3.02, 8.10)	6.26 (3.41, 11.47)*
	Richer	3.40 (2.59, 4.48)	2.93 (2.11, 4.08)*	8.58 (5.06, 14.55)	14.70 (7.54, 28.66)*
	Richest	7.61 (4.93, 11.73)	3.56 (2.06, 6.17)*	35.30 (19.00, 65.60)	94.10 (37.30, 237.35)*
Sex of household head	Male	1	1	1	1
	Female	0.73 (0.56, 0.95)	1.01 (0.71, 1.44)	1.49 (0.91, 2.43)	0.86 (0.45, 1.66)
Sex of the current child	Male	1	1	1	1
	Female	0.78 (0.66, 0.92)	0.72 (0.59, 0.88)*	1.12 (0.81, 1.55)	0.93 (0.62, 1.39)
Age at first birth	≤ 18	1	1	1	1
	18-24	0.98 (0.81, 1.17)	0.81 (0.63, 1.03)	3.41 (2.36, 4.93)	2.71 (1.68, 4.36)*
	≥ 25	0.72 (0.51, 1.01)	0.43 (0.26, 0.71)*	2.32 (1.29, 4.16)	0.33 (0.14, 0.82)*
Births in the past 5 years	One	1	1	1	1
	Two	0.60 (0.50, 0.72)	0.88 (0.70, 1.12)	0.49 (0.35, 0.69)	1.06 (0.68, 1.67)
	Three and above	0.41 (0.29, 0.59)	0.99 (0.64, 1.53)	0.32 (0.09, 1.08)	0.48 (0.10, 2.39)
Birth order	≤ 3	1	1	1	1
	4 to 6	0.68 (0.56, 0.830)	0.61 (0.43, 0.87)*	0.80 (0.52, 1.22)	0.99 (0.48, 2.05)
	≥ 7	0.42 (0.33, 0.52)	0.43 (0.27, 0.66)*	0.17 (0.10, 0.29)	0.38 (0.14, 1.03)

Birth interval	1.016 (1.012, 1.02)	1.01 (1.001, 1.011)*
<i>Hosmer and Lemeshow goodness-of-fit test</i>	<i>P-value = 0.2749</i>	<i>P-value = 0.2289</i>

*p-value < 0.05

Table 6

Bivariate and multivariable analysis of institutional delivery among illiterate and literate reproductive-age women who gave birth in the last five years in Ethiopia, 2019 (n = 3839).

Variables	Description	Institutional delivery			
		Illiterate		Literate	
		COR (95%CI)	AOR (95% CI)	COR (95% CI)	AOR (95% CI)
ANC 1	No	1	1		
	Yes	8.74 (6.89, 11.10)	5.30 (4.00, 7.02)*		
ANC 4	No	1	1	1	1
	Yes	4.44 (3.72, 5.30)	2.28 (1.84, 2.83)*	4.51 (3.50, 5.82)	1.71 (1.22, 2.41)*
Age of the respondent	Less than 24	1	1	1	1
	25-34	0.75 (0.60, 0.92)	0.72 (0.51, 1.01)	0.85 (0.65, 1.10)	0.68 (0.44, 1.04)
	35-49	0.72 (0.57, 0.92)	1.01 (0.64, 1.58)	0.95 (0.64, 1.42)	0.62 (0.28, 1.38)
Place of residence	Urban	1	1	1	1
	Rural	0.45 (0.36, 0.56)	0.98 (0.70, 1.36)	0.36 (0.27, 0.46)	1.37 (0.83, 2.25)
Religion	Muslim	1	1	1	1
	Orthodox	1.15 (0.95, 1.39)	0.60 (0.42, 0.84)*	1.23 (0.89, 1.70)	0.49 (0.29, 0.82)*
	Protestant	0.81 (0.66, 0.99)	0.38 (0.28, 0.51)*	0.35 (0.26, 0.48)	0.24 (0.15, 0.40)*
	Others	0.38 (0.20, 0.76)	0.41 (0.19, 0.92)*	0.05 (0.01, 0.28)	0.03 (0.003, 0.20)*
Region	Tigray	1	1	1	1
	Afar	0.25 (0.11, 0.54)	0.37 (0.14, 0.99)*	0.60 (0.09, 3.91)	1.38 (0.10, 18.52)
	Amhara	0.59 (0.40, 0.85)	0.70 (0.46, 1.08)	0.49 (0.27, 0.91)	0.47 (0.23, 0.94)*
	Oromia	0.46 (0.32, 0.65)	0.73 (0.44, 1.20)	0.23 (0.13, 0.41)	0.34 (0.16, 0.72)*
	Somali	0.21 (0.12, 0.35)	0.94 (0.46, 1.91)	0.12 (0.04, 0.36)	0.38 (0.04, 3.68)
	Benishangul	1.04 (0.46, 2.34)	1.66 (0.61, 4.49)	0.60 (0.16, 2.32)	0.81 (0.15, 4.40)

	SNNPR	0.63 (0.43, 0.92)	1.25 (0.75, 2.09)	0.18 (0.10, 0.31)	0.65 (0.29, 1.48)
	Gambela	1.47 (0.24, 9.05)	2.34 (0.25, 21.85)	0.60 (0.07, 5.14)	2.16 (0.13, 36.08)
	Harari	1.01 (0.21, 4.78)	0.88 (0.14, 5.61)	2.04 (0.03, 124.51)	0.86 (0.01, 81.44)
	Addis Ababa	4.53 (1.30, 15.79)	1.37 (0.35, 5.41)	4.16 (1.16, 14.98)	3.17 (0.58, 17.27)
	Dire Dawa	0.96 (0.28, 3.24)	0.78 (0.17, 3.53)	3.56 (0.10, 128.40)	2.69 (0.02, 438.99)
Family size	≤ 5	1	1	1	1
	> 5	0.49 (0.42, 0.58)	0.67 (0.51, 0.87)*	0.59 (0.46, 0.76)	0.89 (0.56, 1.41)
Wealth index	Poorest	1	1	1	1
	Poorer	2.46 (1.93, 3.14)	1.93 (1.45, 2.56)*	2.62 (1.55, 4.42)	2.65 (1.25, 5.62)*
	Middle	2.74 (2.11, 3.55)	2.20 (1.62, 2.98)*	2.80 (1.75, 4.48)	3.73 (1.88, 7.39)*
	Richer	4.28 (3.27, 5.61)	3.34 (2.41, 4.63)*	7.12 (4.38, 11.55)	8.87 (4.28, 18.36)*
	Richest	10.44 (7.34, 14.87)	5.71 (3.53, 9.25)*	23.93 (14.55, 39.37)	17.74 (7.81, 40.31)*
Sex of household head	Male	1	1	1	1
	Female	0.87 (0.67, 1.14)	0.94 (0.67, 1.32)	2.11 (1.14, 3.09)	0.77 (0.44, 1.34)
Sex of the current child	Male	1	1	1	1
	Female	0.90 (0.76, 1.05)	0.95 (0.78, 1.15)	0.98 (0.77, 1.24)	0.75 (0.53, 1.04)
Age at first birth	≤ 18	1	1	1	1
	18-24	1.06 (0.89, 1.26)	0.99 (0.79, 1.24)	1.84 (1.43, 2.36)	1.33 (0.91, 1.93)
	≥ 25	1.20 (0.86, 1.70)	1.16 (0.71, 1.87)	3.90 (2.33, 6.55)	2.56 (1.13, 5.77)*
Births in the past 5 years	One	1	1	1	1
	Two	0.78 (0.66, 0.93)	1.14 (0.91, 1.41)	0.48 (0.37, 0.62)	0.55 (0.38, 0.79)*
	Three and	0.24 (0.15, 0.36)	0.39 (0.23, 0.55)*	0.45 (0.15, 1.34)	0.36 (0.05, 2.43)

	above	0.39)	0.67)*	1.35)	2.36)
Birth order	≤ 3	1	1	1	1
	4 to 6	0.50 (0.41, 0.60)	0.67 (0.48, 0.92)*	0.63 (0.46, 0.85)	1.76 (0.98, 3.15)
	≥ 7	0.43 (0.35, 0.55)	0.69 (0.45, 1.05)	0.40 (0.24, 0.66)	3.43 (1.12, 10.49)*
Timing of first ANC				0.98 (0.97, 0.99)	0.98 (0.96, 0.99)*
Age of the household head	≤ 29	1	1	1	1
	30 to 44	0.88 (0.70, 1.10)	1.18 (0.85, 1.64)	0.68 (0.50, 0.91)	0.44 (0.28, 0.70)*
	45 to 59	0.98 (0.75, 1.27)	1.38 (0.93, 2.06)	0.41 (0.28, 0.61)	0.33 (0.17, 0.64)*
	above 60	0.69 (0.47, 0.99)	0.78 (0.49, 1.23)	0.52 (0.33, 0.83)	0.49 (0.24, 1.01)
<i>Hosmer and Lemeshow goodness-of-fit test</i>		<i>P-value= 0.1086</i>		<i>P-value = 0.2815</i>	

Table 7

Bivariate and multivariable analysis of postnatal care use among illiterate and literate reproductive-age women who gave birth in the last five years in Ethiopia, 2019 (n =3839).

Variables	Description	Postnatal care use			
		Illiterate		Literate	
		COR (95%CI)	AOR (95% CI)	COR (95% CI)	AOR (95% CI)
ANC 1	No	1	1		
	Yes	11.02 (7.50, 16.19)	5.72 (3.65, 8.99)*		
ANC 4	No	1	1	1	1
	Yes	3.96 (3.24, 4.85)	1.88 (1.46, 2.42)*	3.36 (2.69, 4.21)	1.42 (0.97, 2.10)
Age of the respondent	Less than 24			1	1
	25-34			1.21 (0.96, 1.52)	1.44 (0.86, 2.40)
	35-49			1.37 (0.97, 1.95)	1.10 (0.56, 2.15)
Place of residence	Urban	1	1	1	1
	Rural	0.59 (0.46, 0.76)	1.32 (0.88, 1.99)	0.56 (0.45, 0.69)	1.09 (0.68, 1.75)
Religion	Muslim	1	1	1	1
	Orthodox	1.89 (1.51, 2.37)	1.09 (0.74, 1.61)	1.57 (1.21, 2.05)	0.90 (0.57, 1.44)
	Protestant	0.93 (0.71, 1.22)	0.56 (0.39, 0.81)*	0.52 (0.39, 0.70)	0.62 (0.39, 0.99)*
	Others	0.35 (0.12, 1.01)	0.48 (0.15, 1.53)	0.03 (0.001, 1.17)	0.07 (0.001, 7.59)
Region	Tigray	1	1	1	1
	Afar	0.22 (0.90, 0.56)	0.75 (0.24, 2.37)	0.52 (0.12, 2.13)	0.87 (0.10, 7.61)
	Amhara	0.48 (0.32, 0.70)	0.60 (0.38, 0.96)*	0.45 (0.29, 0.69)	0.48 (0.26, 0.88)*
	Oromia	0.25 (0.17, 0.36)	0.48 (0.28, 0.83)*	0.27 (0.18, 0.41)	0.32 (0.16, 0.61)*
	Somali	0.11 (0.06, 0.23)	0.83 (0.33, 2.07)	0.17 (0.05, 0.53)	0.97 (0.15, 6.44)
	Benishangul	0.71 (0.31, 1.64)	1.31 (0.46, 3.72)	0.50 (0.18, 1.37)	0.53 (0.13, 2.16)

	SNNPR	0.37 (0.25, 0.55)	0.78 (0.45, 1.37)	0.23 (0.15, 0.35)	0.44 (0.21, 0.92)*
	Gambela	0.70 (0.11, 4.35)	1.02 (0.10, 10.13)	0.55 (0.11, 2.79)	1.10 (0.10, 11.94)
	Harari	0.57 (0.11, 3.06)	0.78 (0.10, 6.12)	0.63 (0.09, 4.55)	0.79 (0.05, 11.82)
	Addis Ababa	2.55 (0.97, 6.72)	2.60 (0.66, 10.24)	1.15 (0.64, 2.05)	1.14 (0.50, 2.62)
	Dire Dawa	0.66 (0.18, 2.38)	0.92 (0.18, 4.70)	0.64 (0.16, 2.49)	0.46 (0.07, 3.12)
Family size	≤ 5	1	1	1	1
	> 5	0.68 (0.56, 0.83)	1.05 (0.75, 1.47)	0.91 (0.73, 1.14)	1.19 (0.82, 1.72)
Wealth index	Poorest	1	1	1	1
	Poorer	1.88 (1.37, 2.57)	1.52 (1.04, 2.22)*	1.91 (1.05, 3.48)	0.95 (0.37, 2.43)
	Middle	2.27 (1.64, 3.14)	1.72 (1.15, 2.56)*	2.95 (1.72, 5.05)	2.08 (0.88, 4.89)
	Richer	3.27 (2.36, 4.54)	2.56 (1.70, 3.85)*	5.75 (3.37, 9.79)	4.51 (1.90, 10.71)
	Richest	7.26 (5.06, 10.43)	3.98 (2.29, 6.91)*	7.92 (4.76, 13.17)	1.96 (0.78, 4.91)
Sex of household head	Male			1	1
	Female			1.60 (1.20, 2.14)	0.89 (0.53, 1.49)
Age at first birth	≤ 18	1	1	1	1
	18-24	1.20 (0.98, 1.47)	1.24 (0.95, 1.61)	1.49 (1.19, 1.87)	1.05 (0.73, 1.49)
	≥ 25	0.90 (0.58, 1.39)	1.08 (0.61, 1.91)	5.13 (3.35, 7.86)	4.03 (1.78, 9.15)
Births in the past 5 years	One	1	1	1	1
	Two	0.72 (0.58, 0.89)	1.24 (0.93, 1.66)	0.69 (0.54, 0.87)	1.09 (0.73, 1.63)
	Three and above	0.20 (0.10, 0.41)	0.46 (0.21, 1.01)	1.01 (0.35, 2.93)	1.88 (0.40, 8.78)
Birth order	≤ 3	1	1		
	4 to 6	0.71 (0.57, 0.88)	0.75 (0.53, 1.07)		

	≥ 7	0.66 (0.51, 0.86)	0.98 (0.63, 1.51)		
Birth interval	Short birth interval	1	1	1	1
	Optimal birth interval	2.28 (1.65, 3.15)	1.46 (1.01, 2.12)*	0.98 (0.69, 1.38)	1.21 (0.78, 1.89)
	Long birth interval	3.88 (2.69, 5.59)	1.85 (1.16, 2.97)*	1.50 (1.01, 2.24)	1.36 (0.77, 2.42)
Age of the household head	≤ 29	1	1	1	1
	30 to 44	1.38 (1.03, 1.84)	2.57 (1.56, 4.22)*	0.94 (0.74, 1.20)	0.63 (0.37, 1.06)
	45 to 59	1.48 (1.06, 2.06)	2.69 (1.53, 4.71)*	0.86 (0.60, 1.23)	1.29 (0.64, 2.62)
	above 59	1.27 (0.80, 2.00)	1.92 (0.96, 3.82)	0.71 (0.47, 1.07)	1.10 (0.48, 2.52)
Timing of first ANC visit					0.87 (0.77, 0.99)
# Goodness-of-fit test		<i>Hosmer and Lemeshow test</i> <i>P-value 0.2616</i>		<i>Hosmer and Lemeshow test</i> <i>P-value 0.060</i>	

Figures

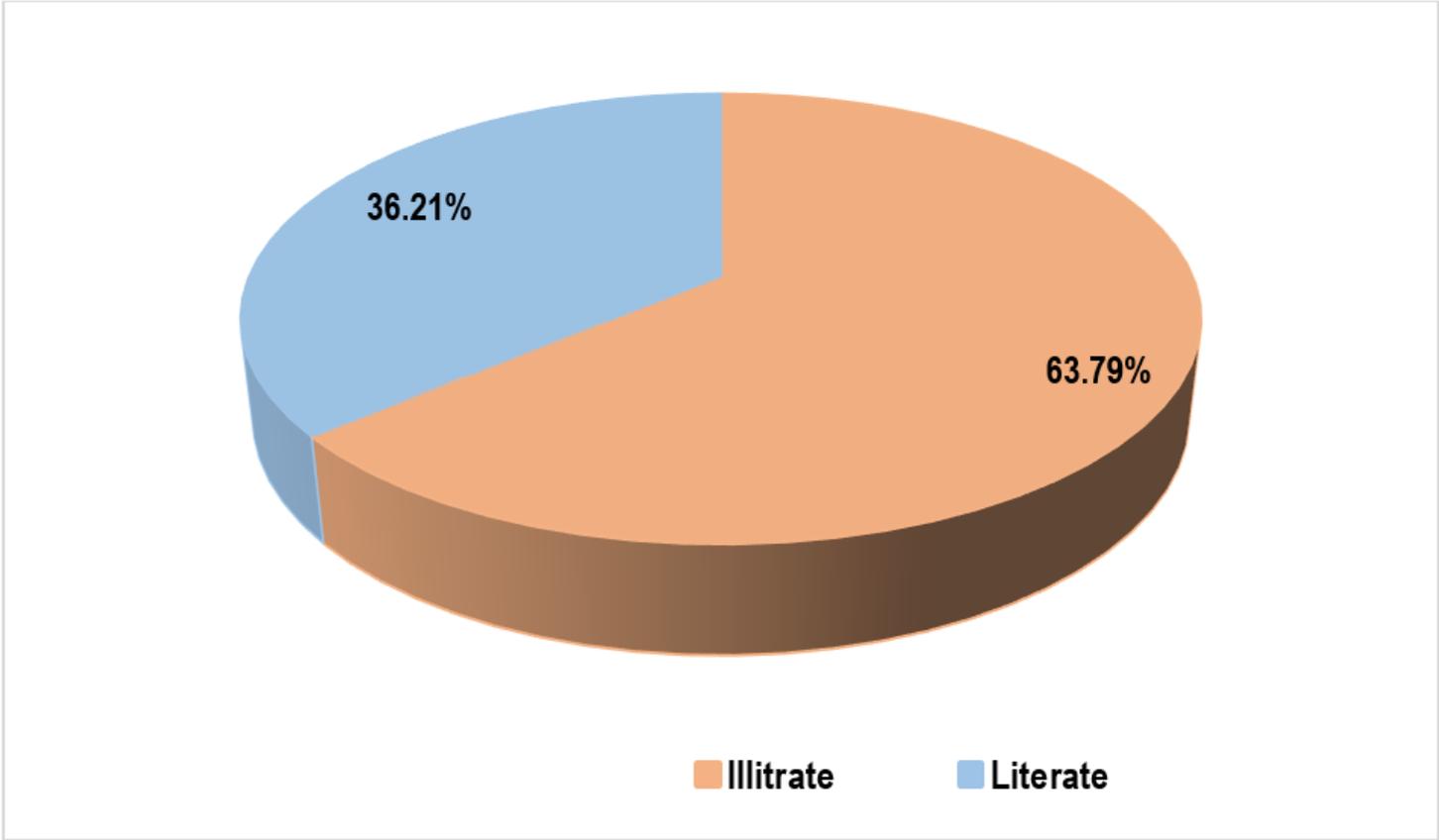


Figure 1

Literacy status of reproductive-age women who gave birth in the last five years in Ethiopia, 2019 (n = 3839)

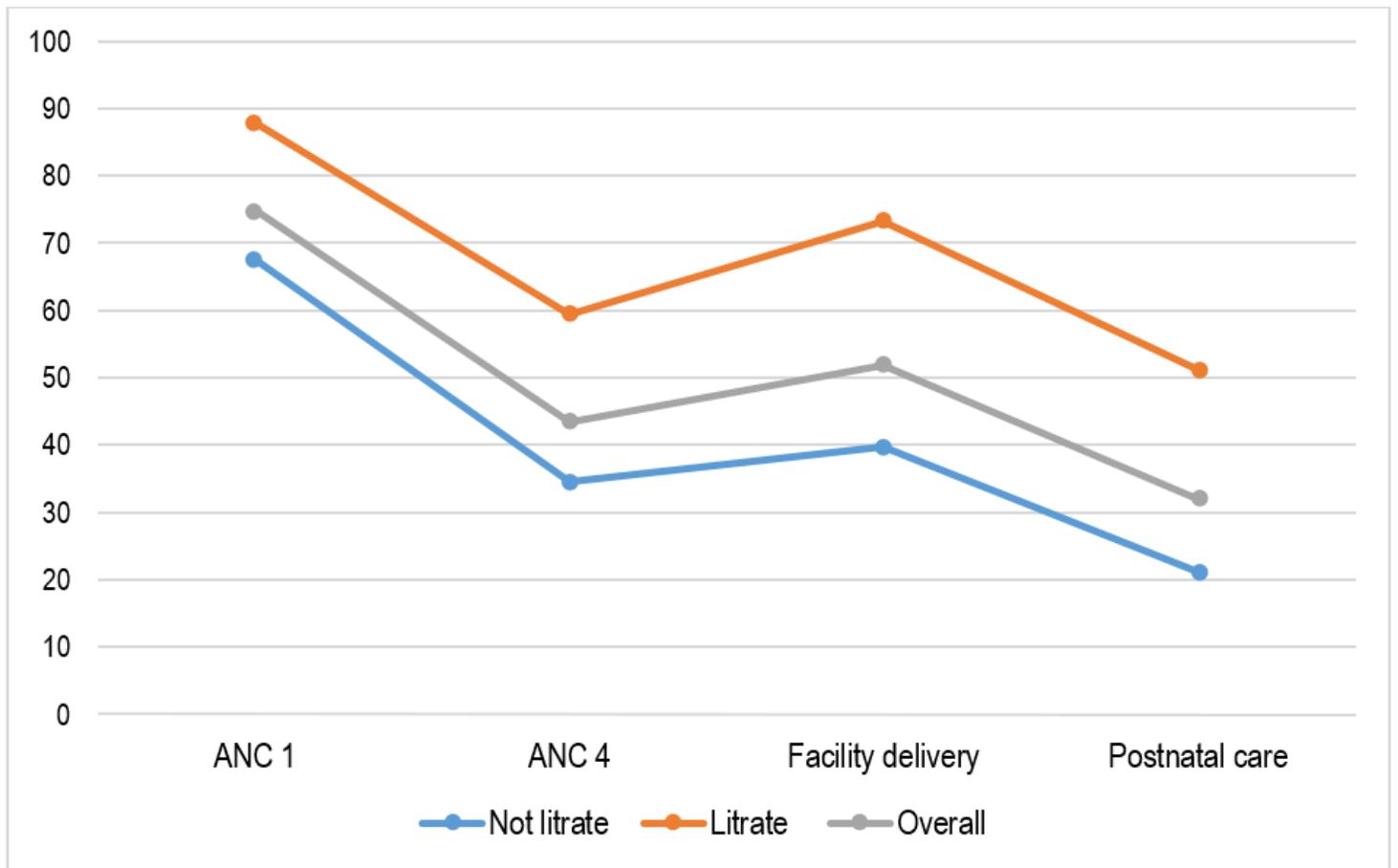


Figure 2

Maternal health service utilization among literate and non-literate reproductive-age women in Ethiopia, 2019 (n = 383)